RESEARCH ARTICLE

Food Supply Adequacy in the Lower Mississippi Delta

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ABSTRACT

Objective: To assess food supply adequacy within 3 food store types in the Lower Mississippi Delta.

Design: Regional food store survey to determine availability and quality of 102 food items in 62 supermarkets, 77 small/medium stores, and 86 convenience stores.

Setting: Lower Mississippi Delta region of the United States.

Participants: 225 food stores in 18 counties.

Main Outcome Measures: Percentage of Thrifty Food Plan (TFP) food items available and quality ratings of 6 food sections across store types.

Results: On average, supermarkets carried 96% of the items that compose the TFP. Mean percentage of TFP carried in small/medium stores was 50%. Convenience stores carried 28% of the TFP items. Supermarkets had higher overall quality ratings and quality ratings for fresh and frozen foods compared to small/medium and convenience stores ($P < .01$).

Implications for Research and Practice: Although supermarkets carried a large percentage of items surveyed, the number of supermarkets in this region is limited. Community residents with limited transportation to reach supermarkets may experience limited food supply adequacy. Therefore, community-based nutrition interventions should include partnerships with small/medium food retailers while trying to impact residents' food choices within those stores.

Key Words: food supply adequacy, food store, survey, rural region

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INTRODUCTION

Food choices ultimately determining diet quality are associated with a variety of personal factors such as educational attainment, socioeconomic status, age, sex, and cultural preferences.[1-5] Likewise, aspects of the local food environment, including food supply adequacy and access, may impact food choices. Food supply adequacy has been conceptualized as including nutritional adequacy based on availability of foods to meet nutritional standards, food safety and quality, and cultural acceptability. Food supply access has been conceptualized as including both economic (affordability) and physical (location of food stores) access.[6-8] Links between the local food environment and healthful food choices are beginning to emerge.[9-17] Often, economically disadvantaged neighborhoods suffer disproportionately with regard to food supply access.[18-20] Although studies of rural and/or low-income residents demonstrate limited access to larger food retailers, they do not provide information on the food supply adequacy within the stores available to these populations. A complete understanding of relationships among food supply access, adequacy, and food choices in at-risk populations requires additional empirical data on availability of healthful food choices.

The Lower Mississippi Delta (LMD) is a rural region characterized by high rates of poverty and food insecurity and a high prevalence of obesity and other nutrition-related chronic diseases.[21,22] Adults in this region consume 20% fewer servings of fruits and vegetables compared to national data and have higher intakes of fat and lower intakes of several micronutrients. Children in the LMD generally have lower intakes of calcium, iron, and vitamins A, C, riboflavin, and B_6 compared to children nationally.[23] Low-income residents of this region have limited access to

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supermarkets.[20] However, little is known about other aspects of the local food environment, such as food supply adequacy within store types. The Delta Nutrition Intervention Research Initiative (Delta NIRI) is a multistate, multiinstitution consortium whose mission is to improve the nutrition-related health of LMD residents through community-based participatory research (CBPR). The focus of this paper is the empirical measurement of components of food supply adequacy in food stores across the LMD, which can then inform CBPR intervention efforts. An ecological model of influences on food choices, dietary behavior, and nutrition and health status, informed by the work of Campbell,[7] Oshaug et al,[6] and Donkin et al,[8] underpinned this research, with adequacy of the food supply and food access at the community level theoretically linked to healthful food choices.

METHODS

Sample

The study was exempt from Institutional Review Board approval at the University of Southern Mississippi since data collection did not involve human subjects. Store managers consented to allow surveyors to collect data on food in the stores, but they were not personally interviewed. The sample consisted of food stores of 3 types (supermarkets, small/medium grocery stores, and convenience stores) in 18 counties representing a larger 36-county region of the LMD of Arkansas, Louisiana, and Mississippi. A 2-stage stratified cluster sampling plan was used to assign the 36 counties to 9 strata according to population size, percentage of the population that was black, and percentage of the population living below the federal poverty level. Eighteen counties (2 from each stratum) were selected with probability proportional to size to represent the strata in a telephone survey of dietary intake and food insecurity of the 36-county region, as well as for a survey of food stores.[24] The sample of 225 stores (62 supermarkets, 77 small/medium stores, and 86 convenience stores) was drawn from a sampling frame of 557 stores stratified by county and store type, which represented the known universe of stores in the 18 counties (79 supermarkets, 205 small/medium stores, and 274 convenience stores). Three food store databases were used to enumerate the universe of food stores: the Store Tracking and Redemption System (STARS) database of authorized food stamp retailers, a food store marketing database from CACI International, and the Internet Yellow Pages (IYP). Stores obtained from STARS (n=501) were preclassified into 1 of 3 categories based on US Department of Agriculture (USDA) classification, which is based on sales data.[25] Stores obtained from the CACI and IYP databases (n=192 and n=51, respectively) were not classified initially. Since sales data were not available for these stores to aid in classifying them, project staff physically screened all stores to determine if they were still open and to classify those from the CACI and IYP databases according to a priori characteristics, defined based on experience from a 3-county pilot study of 35 stores. Measured store square footage was used to classify stores in the pilot study. This method yielded a large degree of variability in store size and other store characteristics within pilot study store classification categories. Therefore, to classify stores from CACI and IYP for the main study, supermarkets were defined as large chain grocery stores with more than 1 cash register; shopping carts; availability of all food sections to be surveyed on the Food Store Survey (FSS) instrument; and a large variety of fresh produce, frozen food, and meats. Results from the pilot study indicated that convenience stores often lacked any full-service departments such as a meat/seafood counter or bakery and were often affiliated with a gas station. If fruits or vegetables were available, they were sold individually. Meat, when supplied, was cold cut or canned. Small/medium grocery stores were classified by exclusion from the other 2 categories. They were smaller than supermarkets, but larger than convenience stores, and often locally owned. They typically had a limited number and variety of the food products within each section to be surveyed.

The intended sample was 5 stores of each type per county, in order to characterize food supply adequacy within each county as a basis for future community-based intervention efforts. Proportional sampling was ruled out as a sampling approach because some counties had only one supermarket. In counties with fewer than 5 stores of a particular type, all stores of that type were sampled. It was not possible to survey 100% of stores of each type in each county in order to capture the single supermarket within some counties. The sample was randomly selected from the list of all stores in the 2 blocks of 9 strata. Within each block, counties and then stores were assigned a random survey order using the random number generator in SPSS version 10.0 (SPSS Inc., Chicago, Ill, 1999). If a store denied permission to survey, the next store in the random order list was approached until the intended sample size was reached.

Survey Instrument and Food Baskets

The format for the survey instrument was adapted from the USDA's Authorized Food Retailer Characteristics Study (AFRCS)[25] and included 102 discrete food items for which data were collected (Table 1). Food item lists were derived from various sources such as the Thrifty Food Plan (TFP) lists, [26] the AFRCS,[25] and foods commonly consumed in the LMD region as determined from the Delta NIRI FOODS validation study and development of the Delta NIRI food frequency questionnaire.[27] Eighty-one of the 102 items were taken from weeks 1 and 2 of the Thrifty Food Plan food lists.[26] For the purposes of this analysis, and to facilitate planned comparisons with national TFP price data, the 67 food items from the week 2 Thrifty Food Plan list, excluding condiments and spices, were defined as the "TFP food basket." A few food items were substituted for items on this list because they were judged to be nutritionally comparable, and because the original food items were found to be almost universally unavailable in stores during the pilot

Table 1. Food Items Included in the Lower Mississippi Delta (LMD) Food Store Survey by Food Section

Fruits and Vegetables
Apples, fresh*†‡
Applesauce*†
Bananas*†‡
Beans, canned (other than green)
Beans, dried (all types)*
Beans, green, canned*†
Beans, kidney, canned*†‡
Beans, lima, canned
Beans, navy beans, canned*‡
Beans, northern, canned*†
Beans, pork and beans*‡
Broccoli, frozen*†‡
Cabbage*†
Carrots, fresh*†‡
Celery, fresh*†‡
French fries, unseasoned, frozen*†‡
Grapes†‡
Green beans, frozen*†‡
Green peas, frozen*†‡
Greens, fresh
Lettuce*†‡
Melon*†‡
Mushrooms, canned†‡
Okra, fresh
Onions, fresh*†‡
Orange juice, concentrate, frozen*†‡
Oranges*†‡
Oranges, mandarin, canned*†‡
Peaches, canned*†
Peaches, light syrup, canned†‡
Pears, canned†
Peas, black-eyed, cream, purple hull, fresh
Peas, dried (all types)*
Peppers, any variety, fresh
Peppers, green bell, fresh†‡
Potatoes, sweet, fresh
Potatoes, white, fresh*†‡
Salad mix, fresh
Spaghetti/pasta sauce, canned*†‡
Spinach, canned†
Squash, summer, fresh*
Squash, winter, fresh*
Squash, yellow, fresh
Squash, zucchini, fresh†
Strawberries, fresh
Tomato sauce, canned*†‡
Tomato soup, canned condensed*†
Tomatoes, fresh*†‡

Breads and Grains
Bagels, plain, enriched†‡
Bread crumbs, dry†‡
Bread, 100% whole-wheat†‡
Bread, French†‡
Bread, white, enriched*†‡
Crackers, snack, low-salt*†
Egg noodles, enriched†‡
English muffins†
Hamburger buns, enriched†‡
Grits, enriched
Macaroni noodles, enriched*†‡
Oatmeal, quick, rolled oats*†
Popcorn, microwave, unpopped*†‡
Ready-to-eat cereal, Corn Flakes*†‡
Ready-to-eat cereal, Toasted Oats*†‡
Rice, enriched*†‡
Rolls, dinner, enriched†‡
Spaghetti noodles, enriched*†‡

Meat, Fish, and Poultry
Bacon, regular sliced*
Beef, chuck roast*†
Beef, ground, lean*†‡
Chicken, thighs*†‡
Chicken, whole fryer*†‡
Fish fillets, fresh or frozen, all types*†‡
Fish, (catfish) fillets, fresh or frozen
Fish, breaded portions*†
Organ meats (liver, kidneys, chitterlings)
Pork chops, bone-in, loin-cut*
Shellfish (shrimp, crab, crawfish)
Tuna fish, chunk-style, water pack*†‡
Turkey ham (deli)†‡
Turkey, breast, bone-in*†
Turkey, ground (or lean ground beef)†‡

Dairy
Cheese, cheddar*†‡
Cheese, cottage, regular, large curd*†‡
Cheese, mozzarella†‡
Eggs (chicken, in shell, large)*†‡§
Fudgesicles, ice milk†‡§
Margarine, low-fat (3g or less) or no-fat, soft, in tub*§
Margarine, regular stick*†‡§
Milk, 1% to 2% milk fat*†‡
Milk, no fat to 1/2% milk fat*
Milk, whole*†‡

Baking Products, Fats, and Sweets
Chocolate chips, semisweet†‡
Cornmeal or cornbread/corn muffin mix*§
Evaporated (not condensed) milk, can*†‡§
Flour, enriched, all-purpose*†‡§
Fruit drink†‡
Jelly*†‡
Molasses†‡
Pancake syrup*†‡
Pudding, chocolate, instant†
Salad dressing, mayonnaise-type*†‡
Shortening, all-vegetable*†‡
Sugar, brown†‡
Sugar, granulated*†‡
Sugar, powdered†‡
Vegetable oil*†‡

*Indicates an item from the Authorized Food Retailer Characteristics Study (n=67)
†Indicates an item from the Thrifty Food Plan Food List, Week 1 or 2 (n=81)
‡Indicates a Thrifty Food Plan Food Basket item (n=67)
§Items grouped into USDA pyramid groups that differed from food sections include item (pyramid group): cornmeal or cornbread/corn muffin mix and enriched, all-purpose flour (grains); eggs (meat); evaporated milk (dairy); as well as ice milk, Fudgesicles, and stick and tub margarine (fats and sweets).

study. Substitutions included pork and beans for vegetarian beans, navy beans for garbanzo beans, and ground beef for ground pork. The items were divided into 5 broad food categories, with subcategories based on form of food. These categories were (1) fruits and vegetables, subdivided by fresh, canned, and frozen; (2) breads and grains; (3) meat, fish and poultry, subdivided by fresh and frozen; (4) dairy; and (5) baking products, fats, and sweets.

Measures of Food Supply Adequacy

The construct of food supply adequacy was defined to include components of availability, particularly the availability of TFP basket items, and quality.[6-8] The complete 102-item food list was referred to as the Food Store Survey (FSS) basket. Other food baskets were defined from the list of 102 food items for analytic purposes other than the one described here and will not be discussed. Availability was

defined as the presence in food stores of food items composing each food basket. Each item was recorded as available or not available. For the TFP food basket, availability was calculated as the percentage of food basket items available in a store. The TFP is a representative meal plan designed to provide a low-cost, healthful diet that meets nutrition standards. It is the basis used to determine the maximum US food stamp program benefit for eligible low-income individuals and families.[26]

Quality was operationalized by assessing the overall quality of each of 6 food sections (fresh fruits, fresh vegetables, frozen fruits and vegetables, fresh meat, frozen meat, and dairy) using a Likert scale rating of 1 to 5. Quality standards were defined for each food section using accepted food purchasing specification standards.[28] Ratings were anchored to specific standards. For example, fresh fruit receiving a 5 was "fresh, firm, free from blemishes, [and had] bright color appropriate for the item." Produce rated 1 "appear[ed] bruised, discolored, wilted, mildewed, moldy or over-ripe." Store surveyors received didactic and experiential training in assessing food section quality by completing a 2-day training session and practice food store survey in a local grocery store to ensure standardized quality assessments. Surveyors were instructed to assess the quality of food items in a section as a whole, rather than tying the quality assessment to particular food items. This approach was adopted based on experience from the pilot study, where individual food items selected to be rated were frequently not available in a given store. An Overall Store Food Quality Rating was constructed for each store by summing individual food section quality ratings and dividing by the maximum possible rating points available (ie, 6 sections x rating of 1-5 for each section yielded an overall score range of 6-30 for stores that included all 6 sections). Food sections not available in a store were treated as missing in calculating the Overall Quality Rating. Thus the range for the Overall Store Food Quality Rating was 0.2 (all sections rated 1) to 1.0 (all sections rated 5). The Cronbach alpha for the overall quality ratings was 0.773.

Procedure

Survey procedures and instruments were pilot-tested in 1 county per state and revised as noted previously. Food stores were surveyed by 2 pairs of trained surveyors. To establish inter-rater reliability, 9% of stores were resurveyed. Agreement between the 2 pairs of surveyors for food availability was nearly perfect (Cohen's kappa = 0.875) (data not shown).[29]

Data Analyses

SAS version 9.1 (SAS Institute Inc., Cary, NC, 2002) was used for data management. Since sampling was not proportional to the number of stores within a given state, the sampling frame was used to weight the stores. Sample weights were constructed as the inverse of the sampling fraction. Weighted summary statistics were calculated using SUDAAN 9.0.1 (Research Triangle Institute, Research Triangle Park, NC, 2005). Because a large proportion of supermarkets was sampled, a finite sample correction was built into the standard error estimates, thus attenuating them. Comparisons between store types were made using pairwise contrasts: two-sided, on the percentage of items available for the TFP basket and the larger 102-item FSS basket, and average overall quality rating and food section quality ratings for store type.

RESULTS

Our intended sample size was 5 stores of each type within a county. However, supermarkets were limited in number, with several counties having fewer than 5 supermarkets in the sampling universe (mean: 4.4; range: 1-11). The final sample consisted of 225 stores rather than the intended 270 (5 stores/type/county x 18 counties). As noted, weighted statistics accounted for the disproportionate store sampling.

Not surprisingly, availability was significantly different by store type for TFP food basket items (Table 2). Small/medium stores had a smaller percentage of items available than supermarkets ($P < .001$) and a higher percentage than convenience stores ($P < .001$). In supermarkets, more than 95% of the TFP was available for all food basket categories except meats, fish, and poultry. Greater variability in availability was found among TFP food categories in small/medium food stores and convenience stores, ranging from 23.4% for frozen vegetables to 71.4% for fats and sweets. For convenience stores, the range by food category was 6.2% for frozen vegetable items to 48.5% of fats and sweets. Similar results were found with the larger 102-item food list (data not shown).

Quality ratings are reported in Table 3. The number of stores of each type included in the quality analyses varied for each food section based on the availability of food items in the particular food section in each store, since stores in which food sections were not available were coded as missing and omitted from the analyses. For dairy food items, found in most stores, 62 of 62 supermarkets, 75 of 77 small/medium stores, and 81 of 86 convenience stores were included in the analyses. At the other end of the availability range was frozen meat, fish, and poultry, for which only 25 of 77 small/medium and 7 of 86 convenience stores were included in the quality analysis.

Overall Store Food Quality Rating varied by store type. Overall rating for supermarkets, at 0.91 (maximum 1), was significantly higher ($P < .001$) than quality ratings for small/medium stores at 0.72 and convenience stores at 0.70, which did not differ from each other.

Mean ratings by food section for all stores ranged from 3.78 out of a possible 5 for fresh fruit to 4.12 for frozen fruits and vegetables. Quality ratings for food sections were consistently higher for supermarkets than for small/medium

Table 2. Percentage of Thrifty Food Plan Food Basket Items Available, by Store Type, and Food Basket

TFP Food Basket Section	All Store Types (N=225)	Supermarkets[1] (n=62)	Small/Medium[1] (n = 77)	Convenience[1] (n=86)
All (67 items)	45.58 (0.72)*	96.24 (0.59)	49.61 (1.21)	28.14 (1.14)
Fruits and vegetables, all (25 items)	37.39 (0.92)	97.52 (0.43)	42.44 (1.77)	16.50 (1.31)
Fruits, fresh (5 items)	27.61 (1.37)	97.20 (0.88)	27.72 (3.00)	7.72 (1.64)
Vegetables, fresh (8 items)	35.56 (1.51)	100.0 (0.00)	45.17 (3.38)	10.02 (1.72)
Fruits and vegetables, frozen (5 items)	25.26 (1.20)	96.92 (0.59)	23.44 (2.88)	6.23 (1.12)
Fruits and vegetables, canned (7 items)	52.70 (1.08)	95.94 (0.57)	61.14 (1.71)	34.08 (1.79)
Cereals and grains (14 items)	51.11 (0.92)	96.95 (0.84)	56.42 (1.39)	34.07 (1.54)
Dairy (7 items)	49.76 (0.94)	97.49 (0.69)	48.20 (1.74)	37.34 (1.40)
Meat, fish and poultry (8 items)	29.03 (0.71)	86.15 (1.53)	26.20 (1.44)	14.89 (0.84)
Fats and sweets (13 items)	63.91 (0.95)	98.57 (0.29)	71.36 (1.33)	48.47 (1.66)

TFP = Thrifty Food Plan
*Mean (SEM)
[1]Availability is significantly different at $P < .001$ by store type

stores. Ratings did not differ between small/medium and convenience stores for fresh items, including fruits, vegetables, meat, fish, and poultry. Dairy food quality was rated higher, and frozen food quality lower, for small/medium compared to convenience stores. However, only 36 small/medium and 12 convenience stores were included in the frozen fruit and vegetable quality ratings, and 25 small/medium and 7 convenience stores in the frozen meat, fish, and poultry quality ratings, because those items were not available in the remaining stores.

DISCUSSION

Access to supermarkets in the LMD is limited, especially for low-income residents.[20] The sampling universe of supermarkets for this survey reflects those findings. Supermarkets in our study averaged 4.4 per county, with a range of 1-11 per county. In 9 of the 18 counties, there were ≤ 4 supermarkets, with 7 of these counties having 3 or fewer. This density is similar to data from another study reporting an average of 3.8 supermarkets per county across the rural United States.[30] Several of the LMD counties in Mississippi have been classified as "food deserts," having low access to large retail food distribution centers.[17] Wide disparities have been noted in levels of physical access to supermarkets in this region between all households and low-income households, with > 70% of low-income households located > 30 miles from a supermarket or large food retailer.[20] Residents of the LMD without access to reliable transportation or whose income limits purchasing gasoline for frequent lengthy trips may be limited to food shopping in small/medium grocery stores and convenience stores that are located closer to their homes. Therefore, it is important to understand food availability and quality in smaller food stores, as these are components of food supply adequacy in a community.[6-8]

Supermarkets carried most of the 67 TFP food basket items. The percentage of available items in the food basket

Table 3. Surveyor Quality Ratings of Store Food Sections by Store Type (mean ± SE)

Food Section	All Store Types	Supermarkets*	Small/Medium*	Convenience*
Overall store food quality rating for all available food sections†	0.74 (0.01)	0.91 (0.01)§	0.72 (0.02)‖	0.70 (0.01)‖
Fruits, fresh‡	3.78 (0.09)	4.56 (0.03)§	3.33 (0.16)‖	3.56 (0.22)‖
Vegetables, fresh‡	3.80 (0.07)	4.59 (0.03)§	3.51 (0.11)‖	3.45 (0.23)‖
Fruits and vegetables, frozen‡	4.12 (0.10)	4.72 (0.19)§	3.49 (0.19)‖	4.44 (0.18)§
Meat, fish, & poultry, fresh‡	3.91 (0.10)	4.35 (0.05)§	3.74 (0.16)‖	3.67 (0.25)‖
Meat, fish, & poultry, frozen‡	4.04 (0.10)	4.33 (0.06)§	3.43 (0.22)‖	4.53 (0.19)§
Dairy‡	3.85 (0.04)	4.82 (0.02)§	3.85 (0.08)‖	3.54 (0.05)¶

*n varies by cell since only stores in which food section was available are included in analysis.
†Overall Store Food Quality Rating for all available sections = sum of individual food section quality ratings ÷ sum of maximum possible rating points for all available sections
‡Quality rating ranged from 1 (low) to 5 (high). Quality standards were defined for each food category.
§,‖,¶Within food section, quality ratings with different superscripts differ from each other, $P < .01$.

dropped significantly in the small/medium category and again in the convenience category across the region. The smaller size of these stores naturally limits the number of food items they can offer. However, considering the documented scarcity of supermarkets,[17,20] it is reasonable to suggest that residents without sufficient transportation have reduced access to a variety of nutritionally adequate foods. The ability to make comparisons among store types was limited to some degree by the methods used to classify stores in the sampling universe that were not in the STARS database by type prior to drawing the sample. In the absence of objective classification data such as sales, the methods used to classify these stores were subjective and may have introduced bias. A standardized classification method, measurement of interior store square footage, was used in the pilot study but abandoned as too costly for the main study, since it required the measurement of all 557 stores in the sampling universe prior to selecting the sample.

Research has shown disparities in the nutritional component of food supply adequacy between lower-income and higher-income neighborhoods[9,12,14] and between remote areas compared to highly accessible areas.[13] In addition, availability of less healthful foods has been shown to be greater than that of healthful foods in low-income areas.[9,12,31] In order to develop a better understanding of LMD residents' access to nutritionally adequate foods, the 102 items from the survey were grouped into Food Guide Pyramid groups and the availability of these groups was assessed across store types. Supermarkets had a significantly higher percentage of the items available in each food grouping than the small/medium or convenience stores owing to the larger size of the stores. However, even in supermarkets, the most available food group was the fats and sweets group. LMD residents who have access to supermarkets have a larger array of food items from which to select healthful options. Those who do not have such access or who must purchase perishable food at small stores in between less frequent trips to larger supermarkets do not.

Food quality, composed of nutritional and sensory attributes, is also considered to be a component of food supply adequacy and a measure of the food environment.[6,32] Little research has attempted to evaluate the quality of food available for purchase in food store settings, in part because of the lack of valid assessment tools.[8,14] The appearance of fresh produce was reported as quite poor in small/medium stores compared to supermarkets in 33 persistently poor rural counties across the United States, and in Los Angeles County markets located in areas with largely poor, African American populations, compared to contrast markets in higher-income areas with lower percentages of African American residents.[30,33] The poor quality of fresh fruits and vegetables was attributed to a lack of refrigeration space in the stores.[30] The study of rural stores used a single open-ended question to evaluate quality of produce. Data on food quality for other sections of these food stores was not collected systematically. In our study, food quality of several sections of the food stores was assessed using a measure that yielded a standardized score so as not to penalize smaller stores on quality for not having a specific food section.

Supermarkets received higher overall quality ratings, across all food sections, than small/medium stores. For overall quality (a composite measure) and 3 of 6 food sections, there were no differences between small/medium and convenience stores. For frozen food items, convenience store quality ratings were higher than for small/medium stores. This finding was possibly related to the small number of convenience stores included in these analyses (12 for frozen fruits and vegetables and 7 for frozen meat, fish, and poultry). Although this measurement of food quality in the food store setting contributes to our understanding of the community food environment in a poor, rural region, there are obvious limitations associated with the quality rating methodology. One is the potential for measurement error related to the subjective nature of the rating system and the rating of a group of food items rather than single food items. Other factors, such as store lighting and display arrangements, could affect perceptions of quality by the surveyors, and quality may differ among food items in the rated food section. Another limitation is the small number of small/medium and convenience stores included in some analyses associated with lack of availability of food items, which reduces the validity of the comparisons made among store types. Nonetheless, the quality differences found among store types reinforce the conclusion that those who have limited access to supermarkets also have reduced access to high-quality fresh and frozen food.

The authors sought to gather information about the local food environment in the region by assessing food supply adequacy within and across store types. Food availability based on nutritional standards such as the TFP is significantly lower in small/medium grocery stores and convenience stores compared to supermarkets. Community residents with limited transportation to reach supermarkets may rely on small/medium grocery stores and convenience stores for more of their food purchases. Naturally, smaller stores will have less space and therefore will be limited in the number and variety of items they can offer. Anecdotally, store managers commented to surveyors that they sold items residents would buy. Therefore, community-based nutrition interventions aimed at improving food choices and nutritional adequacy of residents in the region should include partnerships with these small/medium food retailers while trying to impact residents' food choices within those stores.[34] It is imperative that community residents be willing and take action to purchase new food items such as fresh and frozen fruits and vegetables when they are offered in the store so that small/medium store owners do not suffer adverse economic impacts. Formative research on the food attitudes, knowledge, and behaviors of community residents would allow development of a culturally sensitive nutrition intervention framework to improve residents' food choices in conjunction with changing the food supply within local food stores.[35]

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